

**REMARKS/ARGUMENTS**

Claims 1-20 and 22-24 are pending after entry of this paper. Claims 1-7, 9-12, and 18-23 have been rejected. Claim 21 has been canceled without prejudice. Applicants reserve the right to pursue the subject matter of the canceled claim in a divisional or continuing application.

Claims 6, 9, and 12 have been amended editorially by deleting the phrases that the Examiner found objectionable under 35 U.S.C. § 112, second paragraph.

Claims 2-4, 7, 8, and 13 have been amended editorially to clarify the claimed invention. Additionally, Claim 7 has been amended to depend properly on Claim 1. Support for Claim 7 may be found throughout the instant specification, for example at page 5, lines 18-22.

Claims 1 and 18 have been amended for clarification. Support for Claim 1 may be found throughout the instant specification, for example at page 2, lines 29-30 through page 3, lines 1-28. Support for Claim 18 may be found throughout the instant specification, for example at page 11, lines 14-18. The subject matter of Claim 21 has been incorporated in part into Claim 18.

Claim 24 is a new claim dependent on Claim 18 that has been added to further define the external separator. Support for Claim 24 may be found throughout the instant specification, for example at page 9, lines 15-18 and in original Claim 21.

No new matter has been introduced by this new claim or any of the amendments. Reconsideration and withdrawal of the pending rejections in view of the above claim amendments and below remarks are respectfully requested.

Response to Rejections under 35 U.S.C. §112

Claims 6, 9, and 12 have been rejected under 35 U.S.C. §112, second paragraph for indefiniteness. The Examiner contends that the use of the phrase “such as” in claims 6 and 9 and the phrase “for example” in claim 12 renders these claims indefinite because it is unclear whether the elements following these phrases are part of the claimed invention. Applicants respectfully disagree. However, in order to expedite prosecution and without disclaimer of or prejudice to the subject matter recited therein, Applicants have amended Claims 6, 9, and 12 to remove these phrases. Reconsideration and withdrawal of this §112, second paragraph rejection are respectfully requested.

Response to Rejections under 35 U.S.C. §103

Claims 1-7, 9-12, and 18-23 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Hiltunen et al. (USPN 5,505,907; "the '907 patent") in view of any one of Beisswenger et al. (USPN 4,817,563; "the '563 patent"), Reh et al. (USPN 4,080,437; "the '437 patent"), or Schmidt et al. (U.S. PN 4,402,754; "the '754 patent"). The Examiner specifically contends that the '907 patent does not teach fluidization using Froude numbers and that this teaching may be obtained from any one of the '563, '437, and '754 patents. Applicants respectfully disagree with the Examiner's conclusion.

Briefly, the '907 patent discloses an apparatus for cooling a hot gas in which the hot gas is introduced into the lower section of the apparatus through a supply tube (16) that is surrounded by a bubbling fluidized bed of solid particles (14). As the hot gas flows out of the supply tube, the gas is mixed with solid particles from the fluidized bed and forced through a riser (22) into the upper section of the apparatus. During this mixing step, the hot gas is cooled

as energy is transferred from the hot gas to the cooler solid particles. In the upper section of the reactor, the cool gas is separated from the solid particles with the cool gas exiting the reactor (30) and the solid particles returning to the fluidized bed via the return duct (36).

The '563 patent, the '437 patent, and the '754 patent are all similar in that they disclose traditional circulating fluidized bed reactors for use in reaction systems. Each of these patents discloses a range of Froude numbers that are obtained in the fluidized bed when the respective processes are operated at the reaction conditions disclosed by each patent.

In contrast, the claimed invention discloses a method and plant for physically conveying fine-grained solids both gently and effectively. Specifically, a gas is introduced through the bottom of a fluidized bed reactor via a supply tube (3) surrounded by a stationary, annular fluidized bed of fine-grained solids (10) that is fluidized by a fluidizing gas. As the gas flows out of the supply tube, the gas entrains solid particles from the annular fluidized bed. To ensure effective conveyance of the entrained solid particles out of the reactor via a conveying conduit (13), the velocity of both the supply-tube gas and the fluidizing gas are adjusted such that the following particle Froude numbers are attained in different portions of the reactor: the gas supply tube (3)--between 1 and 100; the annular fluidized bed (10)--between 0.02 and 2; the mixing chamber (7)--between 0.3 and 30.

However, in order to expedite prosecution and without disclaimer of or prejudice to the subject matter recited therein, Applicants have amended Claim 1 to indicate that conveyance of the solid particles out of the fluidized reactor is achieved by adjusting the velocities of both the supply-tube gas and the fluidizing gas such that the particle Froude numbers in the supply tube, fluidized bed, and mixing chamber are within the claimed ranges.

As currently amended, Claim 1 clearly is not obvious over the apparatus of the '907 patent in view of any one of the '563 patent, the '437 patent, or the '754 patent for the following reasons.

Although the '907 patent describes entrained solid particles flowing to the upper section of the '907 apparatus (*see* col. 4, lines 45-53), the gas and solid particle suspension forced to the upper section simply is a by-product of the mixing process and would not suggest to one of ordinary skill in the art a method of conveying solid particles out of the reactor by adjusting the supply-tube gas velocity or the fluidizing gas velocity to obtain specific particle Froude numbers. The '907 patent does not suggest adjusting either the supply tube gas velocity or the fluidizing gas velocity to effectuate effective transport of the solid particles. The only mention of adjusting either of these gas velocities is in reference to creating an overflow of solid particles into the supply tube by adjusting the fluidizing gas velocity so that the top of the fluidizing bed is "at a higher level than the top edge" of the supply tube ('907 patent, col. 6, lines 23-27; *see also* col. 4, lines 62-65). Furthermore, the '907 patent does not teach the use of particle Froude numbers to define operating conditions in the supply tube, fluidized bed, and mixing regions of its claimed apparatus. The '907 patent is merely concerned only with cooling a hot gas by mixing with cool solid particles, a process that occurs "very quickly" and not the transport of the solid particles within the reactor or out of the reactor to an external separator (*see, e.g.*, col. 4, lines 43-45; col. 3, lines 5-8).

Additionally, the Examiner contends that the '907 patent teaches that "a cyclone separator (28) is provided downstream of the reactor and functions to separate the solids from the gas flow" (Office Action – pg. 4). Applicants respectfully disagree. The specification of the '907 patent clearly distinguishes between the reactor (10) and the riser (22) and clearly indicates that the separator (28) is a structural feature of the reactor (10). For example, the specification

states that the “cooled gas containing solid particles is conveyed through the riser . . . and introduced into the upper section of the reactor, where the solid particles are separated from the gas in a particle separator” (col. 2, lines 33-38; *see also* col. 4, lines 8-20). Thus, the solid particles never leave the ‘907 apparatus as the particles that are forced to the top of the ‘907 apparatus are separated from the gas and returned to the fluidized bed while the particle-free gas exits the top of the apparatus (col. 1, lines 15-20). Moreover, the separated solid particles freely flow down the return duct (36) by gravity to the fluidized bed (12) (col. 4, lines 54-55; Fig. 1). Contrast the ‘907 patent to the claimed invention where the gas velocities of both the supply tube gas and fluidizing gas are adjusted such that the solid particles are conveyed out of the fluidized bed reactor. Therefore, based on the ‘907 patent alone, applicants assert that it is not obvious for one of skill in the art to adjust the gas velocities of both the fluidizing gas and the supply-tube gas in order to obtain the claimed particle Froude ranges that would enable the effective transport of solid particles out of the reactor as claimed.

Despite acknowledging that the ‘907 patent does not discuss particle Froude numbers, the Examiner contends that one of ordinary skill in the art would have combined the teachings of the ‘907 patent with the Froude numbers taught by any one of the ‘563 patent, the ‘437 patent, or the ‘754 patent to obtain the claimed invention (Office Action- pg 4). However, Applicants respectfully disagree with the Examiner’s conclusion because the ‘563 patent, the ‘437 patent, and the ‘754 patent each are directed towards traditional circulating fluidized bed reactors for use in reaction systems. Thus, the Froude ranges disclosed by these cited patents pertain only to the reaction conditions in the fluidized beds and not the enablement of the transport of solid particles. Furthermore, the fluidized bed reactors of the ‘563 patent, the ‘437 patent, and the ‘754 patent do not contain a supply tube gas that entrains solid particles in a

mixing chamber above a stationary annular fluidized bed, much less give any indication of the appropriate particle Froude ranges to employ in either the mixing chamber or the supply tube in order to ensure effective transportation of the solid particles out of the reactor. Accordingly, a person of ordinary skill in the art would have no motivation to combine the '907 patent, which discloses an apparatus for cooling a hot gas, with any one of these three secondary patents. The conditions in these prior art fluidized beds are completely different from those of the claimed invention, thus, rendering the Froude range disclosures in the '563 patent, the '437 patent, and the '754 patent meaningless for purposes of enabling the conveyance of solid particles out of the reactor as required by Claim 1.

Applicants have amended Claim 18 to include both an external separator structure and a conveying conduit structure so as to further distinguish the claimed plant from the apparatus disclosed by the '907 patent. As currently amended, Claim 18 clearly is not obvious over the apparatus of the '907 patent in view of any one of the '563 patent, the '437 patent, or the '754 patent. Although the '907 patent provides for a separator to remove the entrained solid particles from the cool gas, this separator either is located internally within the reaction chamber's upper section or operatively connected to the reaction chamber (*see* '907 patent, claims 1 and 18). In either case a return duct always is provided to allow the separated solid particles to return to the fluidized bed (*see* '907 patent, claims 1 and 18). In contrast, Claim 18 of this application, in furtherance of the conveyance method of Claim 1, requires that the external separator and mixing chamber be connected by a conveying conduit that is "possibly distinctly longer than the mixing chamber" (Specification, page 11, lines 16-18). This conveying conduit is a clear structural difference from the apparatus disclosed in the '907 patent. Furthermore, the conveying conduit clearly demonstrates that the solid particles are completely

transferred out of the reactor before being removed from the conveying gas in a separator that has no other connection to the reactor. Finally, the '563 patent, the '437 patent, and the '754 patent do not add anything to this obviousness analysis as these patents do not disclose any information regarding the separation of entrained particles from carrying gases.

There is no motivation or guidance in the cited publications for one skilled in the art to use the claimed Froude ranges in the claimed method of conveying solid particles. Further, the Examiner has improperly used hindsight to reach the present invention from the cited art (which do not teach or make obvious applicants' invention) as there is no motivation to combine these particular references in this particular fashion. The '563 patent, the '437 patent, and the '754 patent do not remedy the insufficiencies of the '907 patent method to result in the claimed method of conveying solid particles. In fact, the combination of cited publications specifically fails to provide motivation for a skilled artisan to use the specific Froude ranges for conveying solid particles according to the claimed invention. Therefore, a combination of the '563 patent, the '437 patent, and the '754 patent does not teach or suggest using the particular Froude numbers to the method of the '907 patent, nor does this combination teach or suggest the methods recited in the rejected claims. Therefore, applicants respectfully request reconsideration and withdrawal of this §103 rejection of Claims 1-7, 9-12, and 18-23 based on the foregoing remarks.

### Dependent Claims

Applicants have not independently addressed all of the rejections of the dependent claims. Applicants submit that for at least similar reasons as to why independent claim(s) 1 and

18, from which all of the dependent claims 2-7, 9-12, 19-20, and 22-23 depend, are believed allowable as discussed *supra*, the dependent claims are also allowable. Applicants however, reserve the right to address any individual rejections of the dependent claims and present independent bases for allowance of the dependent claims should such be necessary or appropriate.

Applicants respectfully submit that the invention as recited in the claims as presented herein is allowable over the art of record, and respectfully request that the respective rejections be withdrawn.

### **CONCLUSION**

Based on the foregoing amendments and remarks, Applicants respectfully request reconsideration and withdrawal of the rejection of claims and allowance of this application. Favorable action by the Examiner is earnestly solicited.

**AUTHORIZATION**

The Commissioner is hereby authorized to charge any additional fees which may be required for consideration of this Amendment to Deposit Account No. **13-4500**, Order No. 4791-4013.

In the event that an extension of time is required, or which may be required in addition to that requested in a petition for an extension of time, the Commissioner is requested to grant a petition for that extension of time which is required to make this response timely and is hereby authorized to charge any fee for such an extension of time or credit any overpayment for an extension of time to Deposit Account No. **13-4500**, Order No. 4791-4013.

Respectfully submitted,  
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